



## Research on the Impact of the Use of Digital Finance on Farmers' Happiness: Intermediary Perspective Based on Livelihood Diversification

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**SUMMARY:** *In light of China's all-round promotion of rural revitalization and the pursuit of common prosperity, enhancing the subjective well-being of the rural population has emerged as one of the basic goals of social development. Digital finance is an advanced system of financial services that integrates high-tech information technology to build new ways of overcoming the barriers to traditional financial inclusion. Systematically investigate the impact and internal mechanisms of digital finance use on farmers' happiness in this paper. Based on the large-scale microdata from the China Household Finance Survey (CHFS) 2019, a general-purpose evaluation system for the use of digital finance has been constructed with three dimensions: digital payment, digital wealth management and digital credit. Based on the results of the ordered Probit (Oprobit) model, it can be concluded that the use of digital finance is positively related to a farmer's sense of well-being. Further exploration will be made in the paper by exploring the link between the two through livelihood diversification. The above results indicate that digital finance has helped farmers move away from the traditional model of monoculture in agriculture to develop multiple income sources through other means, reducing risks and improving the overall wealth of these households. The welfare effects of digital finance under study vary significantly among different research papers. Rural households with lower human capital, limited material assets, and those in economically backward central and western areas are more positively affected by digital finance in terms of happiness. Therefore, "inclusion" of digital finance can alleviate the problems of the Matthew effect in traditional finance. To ensure the stability of the previous results, robustness tests will also be conducted with Conditional Mixed Processes (CMP) and Instrumental Variables (IV). Provide empirical support and policy suggestions for using digital technology to reduce the urban-rural disparity and improve the all-round living standards of smallholder farmers.*

**KEYWORDS:** *Digital finance; Farmers' happiness; Diversification of livelihoods; Oprobit model*

## 1 Introduction

With the healthy development of the rural economy and an increase in the living standards of the farmers, many people have begun to wonder how to make farmers happier. Since the 18th National Congress of the Communist Party of China, the CPC Central Committee has put forward and implemented the idea that "making people happy is the goal of the Party", taking "improving the living conditions and happiness of the people as the main aim of development"

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<https://doi.org/10.65102/is2026888>

and committing itself to "enhancing people's sense of achievement, happiness and security". Farmers' happiness has become the main focus of all-around revitalization of rural areas. Given the current cost pressures and profit-seeking motives, the phenomenon of "disliking the poor and loving the rich" in traditional financial institutions still persists; thus, it has not yet achieved the goal of widespread access to financial services [1]. To solve the current problem, digital finance has appeared in recent years and is a form of financial innovation that integrates digital technology with finance; although it has reduced financial exclusion to some extent, the cost and quality of financial services have not been optimized, and the improvement of the rural financial environment has not further boosted farmers' happiness [2]. Therefore, research has begun to explore how digital finance affects the happiness of farmers in recent years.

Small-scale farmers are the main producers of food and rural life. They are in charge of production and life. We should also consider the risks in our life that can prevent us from being happy. In addition to the traditional risk of natural disasters, there is also the sudden risk of COVID-19. The above risks are serious obstacles to the construction of a stable and prosperous life for farmers and shared prosperity. Livelihood diversification serves to spread the risks of the livelihood system among farmers [3]. Through non-agricultural employment and diversified agricultural cultivation, risks are reduced, insufficient agricultural income can be supplemented, income diversity increased, family living standards improved, and happiness thus increased. At the same time, the traditional model of financial services is no longer suitable for the demands of the long-tail market. Digital financial service models are now leading the reform of the rural financial industry [4]. With new technologies and all sorts of convenient, high-quality services, farmers can now use easy-to-access, safe, personalised, and high-quality financial services [5]. The above reasons can help promote the development of the financial industry and meet the changing demands of modern rural development for financial services [6]. The first kind of impact of financial service reform is that farmers have increased access to funds. Digital finance can also influence the farmers' living-related choices, and at the same time, the flow of transactions will be unconfined by time and space; thus, farmers may be more inclined to participate in non-agricultural activities [7]. The application of digital finance can also address the problem of asymmetric information for farmers by providing them with more information on agricultural employment; thus, it will affect the allocation of household labour resources and job choices, promote the diversification of household livelihood activities, etc. [8] In short, by linking digital finance with farmers' lives and exploring the relationship among farmers' diversified income sources and the use of digital finance, it is hoped that the economic situation of farmers can be improved, household labour resources better organised, household income channels expanded, and thereby farmers' happiness promoted. This all-encompassing effect will help promote the long-term development of rural areas.

Currently, research results on the impact of digital finance use on happiness among the public are not unified. Digital finance can help to utilise a family's money more efficiently [9], motivate people to spend more [10], and thus promote the economy [11]. Digital finance is expected to be more inclusive and boost the happiness of the people. On the other hand, the application of digital finance may face problems of a "digital divide" [12], limiting the convenience that digital technology offers to vulnerable groups, further widening the income disparity among residents, and thus affecting the happiness level of the residents. Therefore, the impact of digital finance on the happiness of residents and the corresponding mechanisms have yet to be investigated in detail.

The two marginal contributions of this paper are that there is a lack of empirical studies on the impact of digital finance use on farmers' happiness in the literature, and that most studies have used the Peking University Digital Inclusive Finance Index as the proxy variable for digital finance. However, this index cannot show how farmers actually use digital finance. Proxy

indicators of digital finance use are generated in this study by counting how many respondents answered the question on the extent to which they have used digital finance to show the impact of digital finance.

## 2 Literature review and theoretical hypotheses

### 2.1 The impact of digital finance on farmers' happiness

There are many problems in the early development of digital finance, such as digital risks [13] and a digital divide [14]; some enterprises have used their dominant position to disrupt the competitive order and reduced customer autonomy [15]. The problems will reduce the people's happiness. However, with the progress of technology and continuous improvements in the financial market supervision system, the new form of digital finance has gradually begun to enhance the quality of life for ordinary people. With the rise of financial services such as digital payments, digital wealth management and digital credit, more people have gained access to finance, and a larger proportion of the "tail group" has actively used digital financial services [16]. Convenience and efficiency of digital payment [17], a low threshold for high return in digital wealth management, and zero cost and zero interest in digital credit [18] meet the needs of farmers, save time and transaction costs, and effectively increase happiness. With the development of digital finance, more entrepreneurial opportunities have appeared for farmers and, at the same time, they have enjoyed the convenience of resource allocation provided by free services [19], thereby realising the goal of "universal preferential" financial convenience and enhanced happiness. It is well-known that, although the development of digital finance has promoted the construction of a rural financial service system, it is still unknown how many people in rural areas have actually used the convenient functions of digital finance and benefited from it. Therefore, this paper will investigate whether digital finance can enhance the living standards of farmers. In short, this paper puts forward hypothesis H1:

H1: The application of digital finance will increase the happiness of farmers.

### 2.2 Analysis on the Mechanism of Livelihood Diversity

Ellis was the first to introduce the idea of diversifying the sources of living for a family, which is to say using resources in a certain way to make life better and easier [20]. Farmers' efforts to increase income and reduce the risk of livelihood changes have been termed livelihood diversification [21]. Agriculture is a main way of life for people in the countryside and is therefore susceptible to risks from natural disasters and market fluctuations. Therefore, a single livelihood model is not risk-free. Spread the risks of economic downturns through diversification of income. Livelihood diversification can also help the poor people in rural areas get out of poverty [22]. Help achieve the goal of common prosperity by redistributing incomes and reducing income disparities among the rural population [23]. Digital finance is developing in rural areas to provide more convenient financial services for farmers, expanding their access to financial services, and helping them participate more actively in all kinds of life and make better living. Participation in various means of life is a farmer's choice of life. Digital finance has been used to increase the participation of rural residents in non-agricultural economic activities, improve the level of livelihood diversification for these families, expand income sources, and raise farmers' income [24]. In addition, the income structure of the residents will boost their consumption power and promote a shift from basic-need consumption to quality-of-life consumption. In short, diversified sources of income have helped boost the rural economy. Application of digital finance can help spread the sources of income for rural residents, increase

their total income, improve their quality of life, and thereby boost their happiness. Hypothesis H2:

H2: The use of digital finance reduces farmers' happiness by restricting their sources of income.

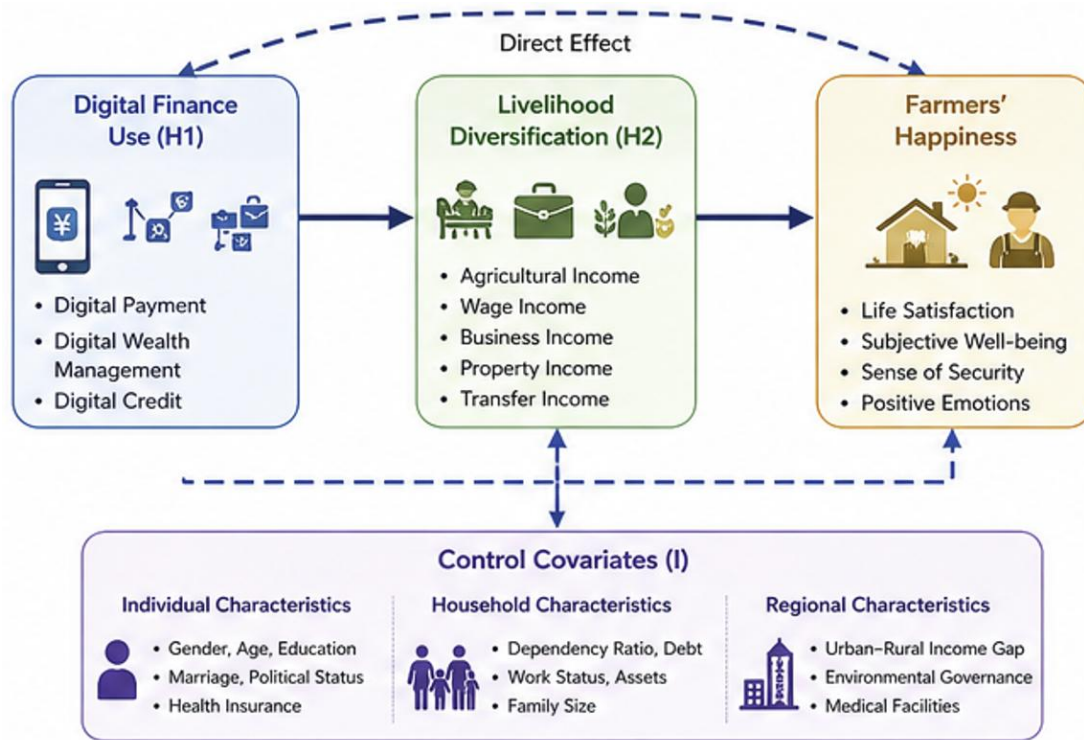


Figure 1: Conceptual Framework and Research Hypotheses

### 3 Study design

#### 3.1 Data sources

Given the scarcity and potential bias introduced by the new coronavirus epidemic, the data in this study are taken from the CHFS2019 statistics database; it is a highly authoritative source in China that provides robust data support for this study. Regional macro data are provided by China Statistical Yearbook 2019. Screening of relevant data for this study. Samples with missing information for urban households and heads of households are excluded, and the impact of abnormal data on the study results is ruled out. After rectifying the missing key variables in the sample, a valid set of 10,161 farmers was obtained.

#### 3.2 Variable definition

(1) Explanation: Farmers' Happiness

In the 2019 CHFS questionnaire, the following question was added: "How happy are you at present?" A Likert five-point scale was used, and the options from 1 to 5 were "Very unhappy", "Unhappy", "Average", "Happy", and "Very happy".

(2) Primary explanatory variable: Digital financial use

Hu Jie *et al.* [25] have used digital payment, digital wealth management and digital credit to indicate the variable of digital finance use in this paper. The specific operation is as follows: First, study digital payment, and CHFS questionnaire mentioned: "When you and your family

are shopping, what payment method do you use? (Payment by Mobile device such as Alipay and WeChat)". Digital finance-related questions: "Does your family have a wealth management APP?" (Yes) and "Does your family buy Internet wealth management products?" (Yes). Digital credit questions include "What is the origin of this loan (online lending platform)?", "How do you plan to obtain the necessary funds (online lending platform)?", and "The reason for overdue payment is (consumer finance company)". Second, set up virtual variables for the three types of financial services. Respondents were considered to have used the appropriate financial service if they selected the option in parentheses, and assigned a value of 1 to such cases; otherwise, they received a value of 0. Finally, by referring to the measurement methods of Zhuang Jiashi (2022)[26] on financial literacy level and Cai Qihua (2016)[27] on social capital level, and through the sum calculation of the three virtual variables of digital payment, digital financial management, and digital credit, the range of farmers' digital financial use is [0, 3], which is taken as the measurement basis for digital financial use. The mean of the digital financial use is selected as a proxy variable.

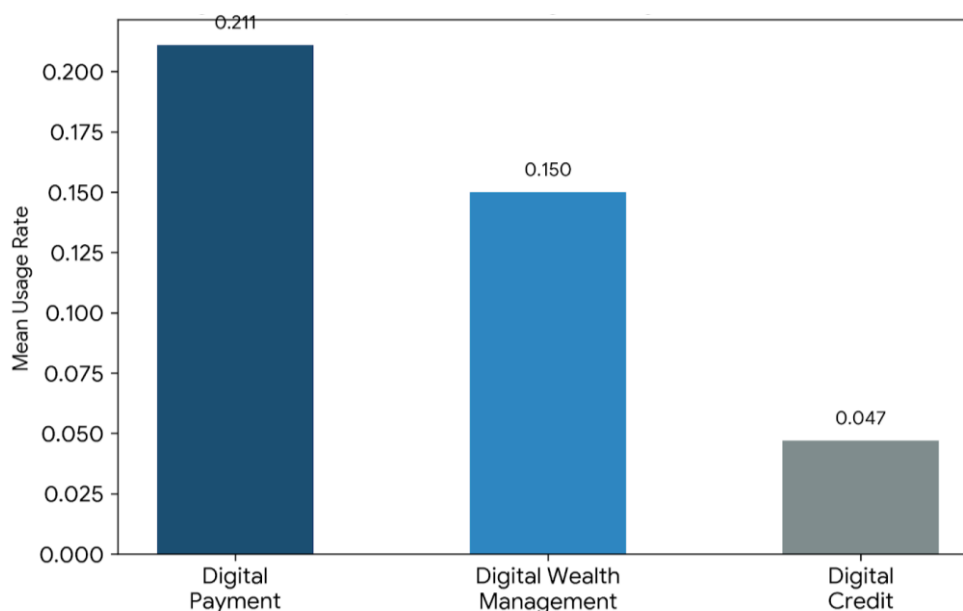


Figure 2: Composition and Usage of Digital Finance Indicators

### (3) Control Variables

Based on previous studies, this study will control for other reasons why farmers might be unhappy. For example, variables of the head of the household's personal information, such as gender, age and education level. Family Characteristic Variables: Debt, Work Status and Dependency Ratio. Regional characteristic variables refer to urban-rural differences in the level of happiness, and these are affected by living standards, living environment, life rhythm, etc. [28] Therefore, macro-level variables in this study are taken as urban-rural income gaps to indicate the imbalance of regional development, environmental governance investment to reflect the regional level of environmental quality, and the number of medical and health institutions in each province as an index of the medical level [29-31].

The assignment, definition and descriptive analysis of the above variables are shown in Table 1:

Table 1: Variable definitions and descriptive statistics

| Types of variables                 | Variables                              | Variables assignment  | Mean value | Standard deviation |
|------------------------------------|--|---|------------|--------------------|
| Explained variable                 | Farmers' happiness                     | 1= Very unhappy;2= Unhappy;3= Average;4= Happy;5= Very happy  | 3.888      | 0.900              |
| Explanatory variables              | Digital finance                        | Proportion of farmers using digital financial services  | 0.135      | 0.251              |
|                                    | Digital payment                        | Not Used =0; Used =1  | 0.211      | 0.408              |
|                                    | Digital wealth management              | Not Used =0; Used =1  | 0.150      | 0.357              |
|                                    | Digital credit                         | Not Used =0; Used =1  | 0.047      | 0.206              |
| Individual characteristic variable | Gender                                 | Female =0; Male =1  | 0.860      | 0.347              |
|                                    | Age                                    | Actual age of respondents/years   | 58.389     | 11.381             |
|                                    | Age squared/100                        | Square of respondents actual age/100  | 35.387     | 13.241             |
|                                    | Education level                        | No schooling =0; primary school =6; junior high school =9; senior high school, technical secondary school and vocational high school =12; junior college and vocational high school =15; university =16; master degree =19; doctor degree =22 | 7.267      | 3.323              |
|                                    | Marriage                               | 1= unmarried;2= married;3= other  | 2.068      | 0.335              |
|                                    | Political appearance                   | Non-member =0; member =1  | 0.121      | 0.326              |
| Household characteristic variable  | Social old-age insurance               | No participation =0; Participation =1   | 0.797      | 0.402              |
|                                    | Child-rearing ratio                    | Number of children (<16 years) divided by total family size   | 0.098      | 0.158              |
|                                    | Old-age dependency ratio               | Number of elderly persons in households (>65 years) divided by total household population   | 0.269      | 0.369              |
|                                    | Asset-liability ratio                  | Total household liabilities divided by total household assets   | 0.242      | 2.293              |
|                                    | Going                                  | No work =0; work =1   | 0.838      | 0.368              |
| Regional characteristic variable   | Urban-rural income gap                 | Urban/rural per capita disposable income  | 2.542      | 0.330              |
|                                    | Investment in environmental governance | Logarithmic investment in environmental governance/ten thousand yuan  | 11.136     | 0.729              |
|                                    | Number of health facilities            | Number of health care facilities digitized/unit   | 7.092      | 0.639              |

Note: Due to the non-linear effect of age, investment in environmental governance and the number of medical and health institutions on farmers' happiness, a square term of age is used, and the investment amount in environmental governance and the number of medical and health institutions are taken logarithmically.

### 3.3 Econometric model

Since the explanatory variable farmers' happiness in this study is an ordered categorical variable,

an Ordered Probit model (hereinafter referred to as Oprobit) has the advantage of considering ordering, flexible adaptability and parameter estimation for ordered categorical data, and is thus used in this research. The model is as follows:

$$\text{happiness}_i^* = \beta_0 + \beta_1 DF_i + \beta_2 x_i + \varepsilon_i \tag{1}$$

$$\text{happiness}_i = \begin{cases} 1 & \text{happiness}_i^* \leq R_1 \\ 2 & R_1 \leq \text{happiness}_i^* \leq R_2 \\ 3 & R_2 \leq \text{happiness}_i^* \leq R_3 \\ 4 & R_3 \leq \text{happiness}_i^* \leq R_4 \\ 5 & \text{happiness}_i^* \leq R_5 \end{cases} \tag{2}$$

In the equation,  $\text{happiness}_i$  is the explained variable resident happiness;  $\text{happiness}_i^*$  is the latent variable of farmer  $i$  happiness;  $R_1, R_2, R_3, R_4, R_5$  is the cut-off point, and  $R_1 < R_2 < R_3 < R_4 < R_5$ ; when  $\text{happiness}_i^*$  is less than cut-off point  $R_1$ , it means that the farmer happiness level is very low, and so on, when  $\text{happiness}_i^*$  is higher than cut-off point  $R_4$ , it means that farmers are very happy;  $DF_i$  is the use of digital finance, which is the core explanatory variable of this paper;  $x_i$  is the control variable;  $\varepsilon_i$  is the interference term.

## 4 Empirical Results and Analysis

### 4.1 Impact of Digital Finance Use on Farmers' Happiness

As shown in the regression results of the OLS model (Table 2), the introduction of digital finance has raised the happiness of farmers. The average marginal effect shows how the level of happiness differs among the categories of farmers. Based on the general regression results, digital finance is positively correlated with farmers' happiness at the 1% level, and the corresponding coefficient is 0.133. Based on the mean marginal effects, it can be seen that, all other variables being held constant, an increase of one unit in digital finance is positively associated with a reduction in the probability of farmers reporting "very unhappy and unhappy" and an increase in the probability of reporting "happy and very happy". Thus, digital finance use can increase the happiness of farmers.

As the farmers age, their health has been declining, their income has dropped, and they have been more isolated, thus reducing their happiness. Farmers with high political status and education tend to have more positive feelings about digital finance use. However, unmarried farmers are happier than married farmers, and it is likely that unmarried farmers have more time and energy for themselves. A higher asset-liability ratio indicates a lower happiness level for farmers; that is to say, the larger the amount of debt a family has taken on, the more strained their living conditions are, and the less happy the farmers will be. The region has shown an increase in urban-rural income disparity, and consequently, the happiness of farmers has declined. Increase investment in environmental governance to enhance the quality of life for the people and build a more sustainable society in the future. However, the expanded coverage of healthcare will reduce farmer satisfaction due to an increase in the risk of health resource waste, uneven quality of care, and high medical expenses.

Table 2: Regression Results of the Impact of Digital Finance Use on Farmers' Happiness

| Variables                              | Ensemble regression  | Average marginal effect |                      |                      |                      |                      |
|--|----------------------|-------------------------|----------------------|----------------------|----------------------|----------------------|
|  | Farmers' happiness   | Very unhappy            | Unhappy              | Average              | Happy                | Very happy           |
| Digital Finance                        | 0.133***<br>(0.044)  | -0.005***<br>(0.002)    | -0.011***<br>(0.004) | -0.030***<br>(0.010) | 0.003***<br>(0.001)  | 0.043***<br>(0.014)  |
| Gender                                 | 0.014<br>(0.034)     | -0.001<br>(0.001)       | -0.001<br>(0.003)    | -0.003<br>(0.008)    | 0.000<br>(0.001)     | 0.005<br>(0.011)     |
| Age                                    | -0.028***<br>(0.009) | 0.001***<br>(0.000)     | 0.002***<br>(0.001)  | 0.006***<br>(0.002)  | -0.001***<br>(0.000) | -0.009***<br>(0.003) |
| Age squared/100                        | 0.034***<br>(0.008)  | -0.001***<br>(0.000)    | -0.003***<br>(0.001) | -0.008***<br>(0.002) | 0.001***<br>(0.000)  | 0.011***<br>(0.003)  |
| Education level                        | 0.009**<br>(0.004)   | -0.000**<br>(0.000)     | -0.001**<br>(0.000)  | -0.002**<br>(0.001)  | 0.000**<br>(0.000)   | 0.003**<br>(0.001)   |
| Marriage                               | -0.118***<br>(0.036) | 0.005***<br>(0.001)     | 0.009***<br>(0.003)  | 0.026***<br>(0.008)  | -0.002***<br>(0.001) | -0.038***<br>(0.012) |
| Political appearance                   | 0.191***<br>(0.034)  | -0.007***<br>(0.001)    | -0.015***<br>(0.003) | -0.042***<br>(0.008) | 0.004***<br>(0.001)  | 0.061***<br>(0.011)  |
| Social old-age insurance               | 0.086***<br>(0.027)  | -0.003***<br>(0.001)    | -0.007***<br>(0.002) | -0.019***<br>(0.006) | 0.002***<br>(0.001)  | 0.027***<br>(0.009)  |
| Child-rearing ratio                    | 0.162**<br>(0.077)   | -0.006**<br>(0.003)     | -0.013**<br>(0.006)  | -0.036**<br>(0.017)  | 0.003*<br>(0.002)    | 0.052**<br>(0.024)   |
| Old-age dependency ratio               | 0.171***<br>(0.045)  | -0.007***<br>(0.002)    | -0.014***<br>(0.004) | -0.038***<br>(0.010) | 0.004***<br>(0.001)  | 0.054***<br>(0.014)  |
| Asset-liability ratio                  | -0.018**<br>(0.009)  | 0.001**<br>(0.000)      | 0.001**<br>(0.001)   | 0.004**<br>(0.002)   | -0.000*<br>(0.000)   | -0.006**<br>(0.003)  |
| Going                                  | 0.110***<br>(0.032)  | -0.004***<br>(0.001)    | -0.009***<br>(0.003) | -0.024***<br>(0.007) | 0.002***<br>(0.001)  | 0.035***<br>(0.010)  |
| Urban-rural income gap                 | -0.128***<br>(0.034) | 0.005***<br>(0.001)     | 0.010***<br>(0.003)  | 0.028***<br>(0.008)  | -0.003***<br>(0.001) | -0.041***<br>(0.011) |
| Investment in environmental governance | 0.120***<br>(0.023)  | -0.005***<br>(0.001)    | -0.010***<br>(0.002) | -0.027***<br>(0.005) | 0.002***<br>(0.001)  | 0.038***<br>(0.007)  |
| Number of health facilities            | -0.053**<br>(0.026)  | 0.002**<br>(0.001)      | 0.004**<br>(0.002)   | 0.012**<br>(0.006)   | -0.001*<br>(0.001)   | -0.017**<br>(0.008)  |
| Wald                                   | 378.720***           |                         |                      |                      |                      |                      |
| N                                      | 10161                |                         |                      |                      |                      |                      |

Note: \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01 indicate significance levels of 10%, 5%, and 1% respectively, and standard errors are indicated in brackets.

## 4.2 Endogenous discussion and robustness test

At one end, we attempt to control some variables at various levels to avoid changes in the outcomes caused by these factors; however, certain unobserved reasons for the happiness of farmers, such as their own cultural backgrounds, economic aspirations and individual differences, are not taken into account. On the other hand, the use of digital finance has been found to increase farmers' happiness, but farmers' happiness may also increase their likelihood of using digital finance; that is, reverse causality exists. Therefore, as shown by Hu Jie et al. [25], the conditional mixed process (CMP) method is employed to estimate the multi-model mixed process of model (1), another exogenous variable is selected for the instrumental variable method (IV2SLS) to test for endogeneity, and a bivariate ranking model (Bioprobit) is used to verify the robustness of the aforementioned endogeneity test.

As shown in Table 3, this paper uses a farmer's attention to financial information as the instrument. Based on correlation, the more financially literate farmers are in general, the higher their awareness of digital finance, and thus the stronger their motivation to use related financial services, leading to an increased likelihood of farmers' digital finance adoption. Although the farmers learned of the financial conditions, it did not raise their sense of well-being. If there is an effect, this effect will also be transmitted via farmers' use of digital finance and other financial products [25]. Therefore, the number of farmers' access to financial news is selected as the instrument variable in this study, and the options of the CHFS questionnaire are divided into 5 degrees from 1 to 5: "never pay attention, rarely pay attention, general, very concerned, very concerned". To avoid endogeneity problems in the regression results, the three methods listed above are used to test whether the selected instrument variables are correlated with the error term and exogenous.

Table 3 shows the regression results of the CMP model, IV2SLS model and Bioprobit model. Based on the results of the first phase of the study, farmers' attention to financial information is positively correlated with the use of digital finance; thus, increasing farmers' attention to financial information is likely to promote the application of digital finance, and thus there is a correlation between the instrumental variables. To confirm the relationship between the instrumental variable and the explanatory variable, a weak instrumental variable test was conducted using IV2SLS regression, and the F value was 31.445; as this is significantly greater than 10, it can be concluded that there is no weak instrumental variable and a correlation exists between the instrumental variable and the explanatory variable. The results of CMP and Bioprobit models show that the endogenetic test parameters  $\text{atanrho}_{12}$  and  $\text{athrho}$  pass the significance level test; thus, the model estimates are valid, and digital finance is an endogenous variable. It should be noted that the dependent variables in both stages of the Bioprobit model need to be ranked variables, and this is in line with the concept of the benchmark model in this paper. Based on the regression results of the model, the regression coefficient for digital finance may be an overestimate of the effect of using digital finance on farmers' happiness due to potential endogeneity [22].

Table 3: Endogeneity Test Results

| Variables                       | CMP model           |                     | IV 2SLS             |                    | Bioprobit model     |                      |
|---------------------------------|---------------------|---------------------|---------------------|--------------------|---------------------|----------------------|
|                                 | The first phase     | Second stage        | The first phase     | Second stage       | The first phase     | Second stage         |
| Digital finance                 |                     | 1.924***<br>(0.650) |                     | 1.707**<br>(0.717) |                     | 0.390***<br>(0.063)  |
| Financial information attention | 0.013***<br>(0.002) |                     | 0.013***<br>(0.002) |                    | 0.082***<br>(0.013) |                      |
| Individual variables            | control             |                     | control             |                    | control             |                      |
| Household variables             | control             |                     | control             |                    | control             |                      |
| Regional variables              | control             |                     | control             |                    | control             |                      |
| $\text{atanrho}_{12}$           |                     | -0.452**<br>(0.188) |                     |                    |                     |                      |
| $\text{athrho}$                 |                     |                     |                     |                    |                     | -0.365***<br>(0.071) |
| F value                         |                     |                     | 31.445              |                    |                     |                      |
| Wald                            | 2087.080***         |                     | 345.060***          |                    | 463.480***          |                      |
| N                               | 10161               |                     | 10161               |                    | 10161               |                      |

Note: Because CMP, IV2SLS is a one-stage regression and OLS, the results of one-stage regression are the same. In Bioprobit model two-stage regression, the explanatory variable is generally the ranking variable. A numerical financial ranking variable is employed in the regression analysis to reduce the impact of estimation on the parameters.

Although the endogenous problem has been solved according to the above discussion, it has not been verified that the research results are both reliable and stable. Further robustness tests will be conducted through the following two channels: (1) Altering the way of measurement for the explained variable. Refer to Yin Zhichao et al. [32] to build the dummy variable of farmers' happiness, define "happiness" and "very happy" as happiness, assign 1, and set all others as unhappiness, assign 0. Referencing Hu Jie et al. [25], construct the sorting variable for farmers' happiness, assigning 1 to "very unhappy" and "unhappy", 2 to "average", and 3 to the rest; (2) adjust the regression model. Replace the Oprobit model with an Ordered Logit (Ologit) model and a Poisson model. The results are as follows: Table 4

All the models in the Wald test are significant, so both robustness tests have achieved some degree of reliability. In addition, the estimation coefficient for digital finance is positively correlated; thus, the use of digital finance can promote people's well-being, and the estimation results of this study are reliable as well as the conclusions. Hypothesis 1 has been verified.

Table 4: Robustness Test Results

| Models                            | Digital finance     | Individual variables | Household variables | Regional variables | Wald       | N     |
|-----------------------------------|---------------------|----------------------|---------------------|--------------------|------------|-------|
| Oprobit model (sorting variables) | 0.130**<br>(0.050)  | control              | control             | control            | 292.730*** | 10161 |
| Oprobit Model (dummy variables)   | 0.592***<br>(0.096) | control              | control             | control            | 189.180*** | 10161 |
| Ologit model                      | 0.179**<br>(0.077)  | control              | control             | control            | 388.030*** | 10161 |
| Poisson model                     | 0.032***<br>(0.009) | control              | control             | control            | 399.670*** | 10161 |
| Ologit model (sorting variables)  | 0.156*<br>(0.088)   | control              | control             | control            | 284.080*** | 10161 |
| Ologit model (dummy variables)    | 1.259***<br>(0.212) | control              | control             | control            | 199.150*** | 10161 |

## 5 Mechanism testing and heterogeneity analysis

### 5.1 Mediating effect testing based on livelihood diversification

Based on the above studies, digital finance can be expected to raise farmers' levels of happiness. Based on the preliminary inference of the review part, digital finance will help more farmers establish diversified income sources and increase their income through the expansion of opportunities. Therefore, this section will verify whether livelihood diversification mediates the positive effect of digital finance use on happiness. The model of mediation effects is as follows:

$$\text{happiness}_i^* = \beta_0 + \beta_1 \text{DF}_i + \beta_2 \text{x}_i + \varepsilon_i \quad (3)$$

$$\text{inc}_{div}_i = \alpha_0 + \alpha_1 \text{DF}_i + \alpha_2 \text{x}_i + \varepsilon_i \quad (4)$$

$$\text{happiness}_i^* = \lambda_0 + \lambda_1 \text{DF}_i + \lambda_2 \text{inc}_{div}_i + \lambda_3 \text{x}_i + \varepsilon_i \quad (5)$$

In the equation,  $happiness_i^*$  is the explanatory variable farmer happiness;  $DF_i$  is the explanatory variable digital financial use;  $inc\_div_i$  is the mediator variable livelihood diversification;  $x_i$  is the control variable;  $\varepsilon_i$  is the random error term. If the coefficients of digital financial use and livelihood diversification in model (4) and model (5) are significant, it indicates that there is a mediation effect.



Figure 3: Mechanism of Farmers' Livelihood Diversification Measurement

The middle link in this study is diversification of livelihood. Livelihood diversification behaviour for farmers can increase their income, as mentioned in the previous description. Thus, income source diversification will be used as the indicator for measuring livelihood diversification. We should consider all the ways people will make a living and make them fair for everyone. The proportion of different sources of household income in total household income can be determined. Simpson's index can be used to measure the diversity of sources of income, and the research results are presented by Si Chuanning et al. [8] Simpson's Index is given by:

$$Simpson_i = 1 - \sum_{k=1}^N p_{i,k}^2 \tag{6}$$

In formula (6),  $N$  represents the number of income sources of farmer  $i$ . The income sources in CHFS database include wage income, agricultural income, industrial and commercial income, property income and transfer income. The maximum value is 5;  $p_{i,k}$  is the proportion of  $k$ th income source of farmer  $i$  in total income of farmers; the value range of Simpson index is  $[0,1]$ . If farmer  $i$  has only one source of income, the Simpson index is 0, and the Simpson index increases with the variety of household income sources, and the degree of livelihood diversification increases. The average Simpson index is 0.27, indicating a low level of livelihood diversification.

Table 5 shows the test results of mediation effects. Result (1) shows that the estimation coefficient of the use of digital finance by farmers in promoting their happiness is 0.133, and it is statistically significant at the 1% level, in line with the previous findings. Results (2) After adding income source diversification, the impact of digital finance use on farmers' happiness is still positive and significant; thus, it can be concluded that digital finance helps expand the types of income for farmers and promotes their behavior of diversified livelihood. Column (3) When both the use of digital finance and farmers' income diversification are considered simultaneously, the regression coefficient of digital finance is still positive and significant, and the coefficient for income diversification is also positive, reaching a significance level of 1%. Therefore, the farmers' income diversification can serve as a medium. According to the Sobel

test, the proportion of the total effect of digital financial use on farmers' happiness explained by income diversification was 4.011%, with a Z value of 2.569 and a P value of 0.010 at the 1% significance level; thus, mediation was confirmed. Bootstrap test was used to substitute the test method. After sampling 1000 times, the results showed that the confidence interval of the indirect effect did not contain 0 and the coefficient was positive; thus, it can be concluded that there was an indirect effect, income diversification acted as a mediator, and the direct effect did not equal 0; therefore, even though the use of digital finance directly affected farmers' happiness, it also influenced farmers' happiness indirectly by promoting income diversification. Hypothesis H2 is accepted.

Table 5: Tests for the Mediating Effect of Livelihood Diversity

| Variables                            | (1)                         | (2)                    | (3)                 |
|--------------------------------------|-----------------------------|------------------------|---------------------|
|                                      | Farmers' happiness          | Income diversification | Farmers' happiness  |
| Digital finance                      | 0.133***<br>(0.044)         | 0.030***<br>(0.008)    | 0.128***<br>(0.044) |
| Diversification of sources of income |                             |                        | 0.199***<br>(0.055) |
| Individual variables                 | control                     | control                | control             |
| Household variables                  | control                     | control                | control             |
| Regional variables                   | control                     | control                | control             |
| Mesomeric effect                     | Sobel                       | 4.011%                 |                     |
|                                      | Bootstrap                   | 4.011%                 |                     |
| Sobel test                           | Z value 2.569 P value 0.010 |                        |                     |
| Bootstrap test                       | indirect effects            | 0.002                  | 0.010               |
|                                      | direct effects              | 0.046                  | 0.188               |
| N                                    | 10161                       |                        |                     |

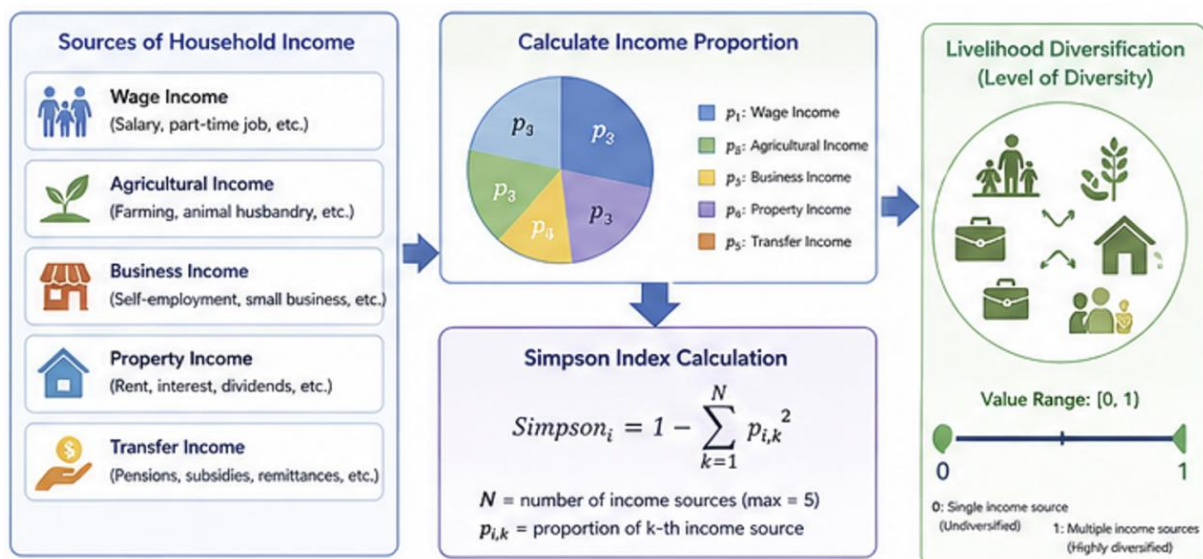


Figure 4: Empirical Results of the Structural Path Analysis

## 5.2 The Impact of Digital Financial Heterogeneity on Farmers' happiness

Although digital finance has improved the living standards of some farmers to a certain extent,

not all farmers are in a similar situation and therefore have not experienced these benefits.

Table 6 shows the regression results of the effect of digital finance heterogeneity on farmers' happiness. Based on the above analysis, it can be determined that digital payment and digital finance can increase the happiness of farmers; thus, both digital payment and digital wealth management have a positive impact on enhancing farmers' happiness, but digital credit does not. The reason is that digital payment has the features of convenience, speed, efficiency and economy; it reduces the search cost and transaction cost, changes the consumption habits of farmers, increases household consumption expenditure, meets the autonomous demand for changes in consumption behaviour very well, and effectively improves happiness [18]. Digital financial tools can help farmers manage their money and digital financial products can assist farmers in accumulating wealth; thus, to a certain extent, the problem of insufficient family financial asset stock has been addressed, and the living standards and happiness of the farmers have been enhanced [3]. However, rural finance will be under the dual constraint of traditional credit and digital credit in the course of digital transformation [33]. In the short run, farmers' acceptance and cognition of digital credit are still at a relatively low level [34], and thus it may be that the impact of using digital credit on farmers' happiness is not significant.

Table 6: The Impact of Digital Financial Heterogeneity on Farmers' Happiness

| Variables                 | Ensemble regression | Average marginal effect |                      |                      |                     |                     |
|---------------------------|---------------------|-------------------------|----------------------|----------------------|---------------------|---------------------|
|                           | Farmers' happiness  | Very unhappy            | Unhappy              | Average              | Happy               | Very happy          |
| Digital payment           | 0.070***<br>(0.027) | -0.003**<br>(0.001)     | -0.006**<br>(0.002)  | -0.016***<br>(0.006) | 0.001**<br>(0.001)  | 0.022***<br>(0.009) |
| Digital wealth management | 0.101***<br>(0.030) | -0.004***<br>(0.001)    | -0.008***<br>(0.002) | -0.022***<br>(0.007) | 0.002***<br>(0.001) | 0.032***<br>(0.010) |
| Digital credit            | 0.002<br>(0.049)    | -0.000<br>(0.002)       | -0.000<br>(0.004)    | -0.000<br>(0.011)    | 0.000<br>(0.001)    | 0.001<br>(0.016)    |
| Individual variables      | control             | control                 | control              | control              | control             | control             |
| Household variables       | control             | control                 | control              | control              | control             | control             |
| Regional variables        | control             | control                 | control              | control              | control             | control             |
| N                         | 10161               | 10161                   | 10161                | 10161                | 10161               | 10161               |

### 5.3 Individual Difference Analysis of Digital Finance's Influence on Farmers' Happiness

The differences in human capital, material capital and region are shown in Table 7 below. The regression coefficients of the Oprobit model cannot be directly compared and are only used to determine the direction; therefore, this study attempts to use OLS for analysis, assuming that the model is correct, the results of Oprobit regression on happiness (an ordered variable) and ordinary least squares (OLS) regression on continuous variables are the same [35].

Sub-human capital. Based on the years of education for farmers, those with primary school education or less were classified as the low human capital group, and those with primary school education or more were divided into the high human capital group. The application of digital finance has achieved some inclusiveness for those with low human capital by reducing the

"threshold" of financial services and providing more financial tools and resources for farmers with a low level of education; thus, it has helped to improve their economic situation and quality of life, reduce the occurrence of "self-exclusion", and boost their sense of happiness.

Material capital. Based on the median of farmers' per capita annual income, farmers below the median are classified as belonging to a low material capital group, and those above the median are in a high material capital group. Digital finance use has a better effect on the happiness of the low-material-capital group, and digital finance use has a certain promotion effect on high-income farmers, but this effect is not significant. High-income families are likely less constrained by liquidity, and thus the additional happiness gained from using digital finance is relatively small. Although low-income farmers are among the recipients of financial assistance, their financing requirements remain relatively high; therefore, the low barriers and convenience of digital finance do not offer them much opportunity for accessing loans or accumulating savings easily, and thus have had a small positive impact on their happiness.

By Area. Divide the entire sample into eastern, central and western areas, and the results show that the use of digital finance has a positive impact on farmers' well-being in all regions; at a significant level, the central and western regions have a better effect than the eastern regions, indicating that the support provided by digital finance is concentrated in the underdeveloped areas to improve the lives of farmers in the central and western regions more effectively. Perhaps because the eastern area is relatively rich in funds, has extended coverage for financial services and a large number of financial products, farmers in the eastern area have benefited significantly from the above advantages. Many families in the central and western areas have fragile livelihoods, are susceptible to external environmental fluctuations, face various deficiencies in their own conditions, and thus cannot obtain financial benefits and are subject to financial crowding out. To address the problem of uneven development in different areas, digital finance will prioritize supporting the construction of weak links. Therefore, digital finance will be able to make the people in the central and western regions happier.

Financial development has positively affected the overall happiness of the people at present. The results are in line with what scholars have found; that is, the impact of digital finance on the happiness of farmers with low human capital, low material capital and in Western regions is relatively pronounced.

*Table 7: Individual Differences in the Impact of Digital Finance Use on Farmers' Happiness*

| Variables            | Human capital       |                    | Material capital   |                   | Region            |                     |
|----------------------|---------------------|--------------------|--------------------|-------------------|-------------------|---------------------|
|                      | Low                 | Tall               | Low                | Tall              | East              | Midwest             |
| Digital finance      | 0.164***<br>(0.064) | 0.094**<br>(0.046) | 0.140**<br>(0.063) | 0.078*<br>(0.046) | 0.101*<br>(0.061) | 0.151***<br>(0.047) |
| Individual variables | control             | control            | control            | control           | control           | control             |
| Household variables  | control             | control            | control            | control           | control           | control             |
| Regional variables   | control             | control            | control            | control           | control           | control             |
| R <sup>2</sup>       | 0.042               | 0.041              | 0.048              | 0.037             | 0.056             | 0.041               |
| N                    | 5061                | 5100               | 5080               | 5081              | 3370              | 6791                |

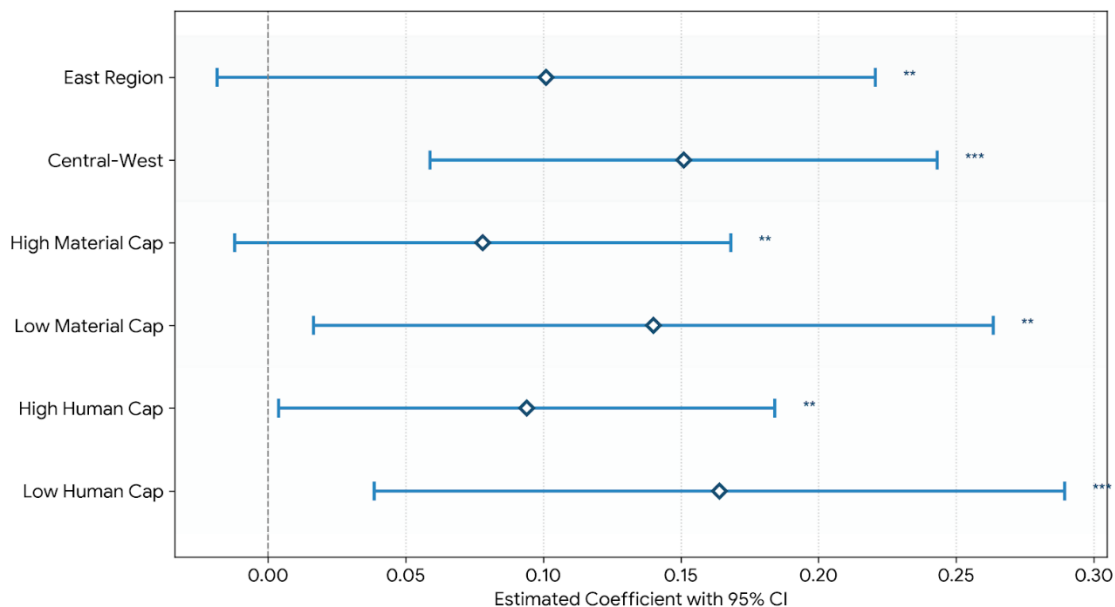


Figure 5: Results of Multi-dimensional Heterogeneity Analysis

## 6 Conclusions and recommendations

### 6.1 Conclusions

Using China's household finance survey data, this paper empirically investigates the impact of digital finance on the improvement of happiness and builds a mediation path of "digital finance use - livelihood diversification - farmers' happiness". Employ a mediation effect model to study how the use of digital finance affects farmers' happiness, and simultaneously examine the mediating role of livelihood diversification. Finally, the effect of heterogeneity in digital finance among different groups and areas for farmers' happiness will also be included. The above are the conclusions: The application of digital finance can enhance the happiness of farmers and increase their sense of "happiness" or "very happy". Despite the endogenous problems and robustness tests, the above conclusion remains valid. Digital finance can also boost the farmers' happiness directly and spread their income from different types of life. Although digital payments, digital wealth management and digital credit have had a positive impact on farmers' happiness, the promotional effect of digital credit has been less pronounced; it may be that the digital transformation faces the double constraints of the alternation of old and new credit, and due to the "inclusiveness" and "low threshold" of digital finance, there is an effect on farmers' happiness with low human capital and low material capital. Due to the impact of the financial environment and policies, the benefits for farmers' happiness from the use of digital finance have been more evident in central and western China.

### 6.2 Recommendations

Based on the above conclusions, this study puts forward the following suggestions: First, vigorously develop digital finance, popularize digital finance-related knowledge, combine the conclusions of individual differences analysis, set up digital finance knowledge training classes, popularize digital finance knowledge, promote farmers to accept and apply digital finance, in order to promote the development of digital finance. In response to the demand for digital financial services by farmers, we will continuously innovate rural digital financial products and

strengthen the development of digital payment, digital wealth management and digital credit service systems. In addition, we will adjust the entry threshold for digital finance, expand support for vulnerable groups such as those with low education and low income, and enhance their sense of participation and learning of digital financial services to promote a marginal increase in farmers' happiness through the use of digital finance. Second, we need to expand the sources of farmers' income and support the construction of a diversified living system for farmers. We should make full use of the advantages of digital finance, optimise resource endowments and factor allocation, enrich rural assets, improve the rural welfare system, ensure farmers' property rights and property income, and increase farmers' property income. Leverage digital credit and other digital financial products to ease financing constraints and expand the development of agricultural income. Support more diversified forms of farmer entrepreneurship and other businesses, not just "survival" entrepreneurship. The government can offer farmers a variety of career options, boost the initiative of farmers for entrepreneurship, use Internet information technology to build training platforms, improve farmers' entrepreneurial skills, and expand diversified income. Strengthen farmers' understanding of digital credit and optimise digital credit service models and products. The government and financial institutions need to promote the popularisation of digital credit and increase the farmers' awareness and acceptance of digital credit. Second, based on the farmers' own needs and usage habits, optimise the model and products of digital credit services to offer more flexible, convenient and secure digital credit services. Strengthen the regulatory and policy support for digital credit to enhance farmers' trust in the services, increase their satisfaction with life, and provide further support and guarantees for the development of digital credit.

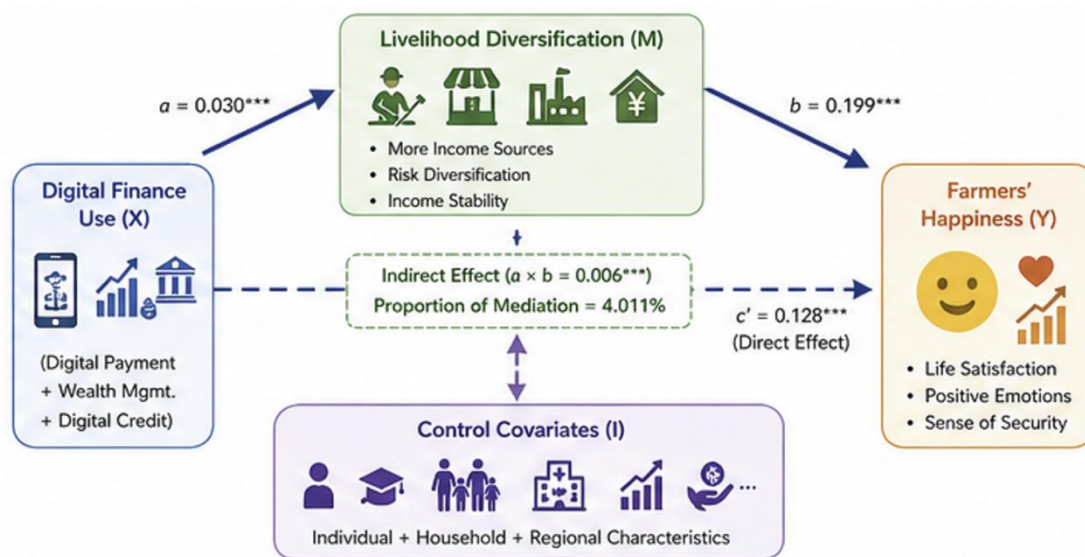


Figure 6: Strategic Roadmap for Rural Revitalization and Well-being

## Funding

National First-Class Undergraduate Course Construction of "Securities Investment" at Mianyang City College (CC-GJYLKC2501)

Research on the Impact of the Use of Digital Finance on Farmers' Happiness, Mianyang City College (2025XJKY27)

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## References

- [1] Fan, X., Liu, B., & Zou, K. (2018). Research on Financial Inclusion, Entrepreneurship Choice and Fair Income Distribution. *China Soft Science*, (09), 64–75.
- [2] Wang, Y., Tu, Z., & Wang, Q. (2023). An empirical test of the effect of digital finance on national happiness. *Statistics and Decision Making*, 39(09), 153–157.
- [3] Wang, J., Lv, X., & Lv, K. (2021). Study on the impact of digital financial use on farmers' livelihood diversification. *Rural Economy*, (08), 62–71.
- [4] Song, W., Huang, Z., & Ye, C. (2023). The impact of digital finance on rural household livelihood strategy choice: evidence from a follow-up survey of rural households in China. *Rural Economy of China*, (06), 92–113.
- [5] Liang, S., & Liu, P. (2019). Digital inclusive finance and urban-rural income gap. *Journal of Capital University of Economics and Business*, 21(01), 33–41.
- [6] Wen, T., & Chen, Y. (2020). Integrated development of digital economy and agricultural rural economy: practical mode, realistic obstacles and breakthrough path. *Agricultural Economic Issues*, (07), 118–129.
- [7] Yin, Z., Wang, L., & Zhang, C. (2023). The effect of digital finance development on residents' happiness since the 18th CPC National Congress. *Financial Economics Research*, 38(01), 52–64.
- [8] Si, C., Li, Y., & Sun, L. (2022). Digital financial ability, income diversification and household consumption upgrading. *Consumer Economics*, 38(06), 70–80.
- [9] An, Q., & Bai, L. (2022). Digital finance development and household financial asset allocation-an empirical study based on CHFS (2019) survey data. *Economic Issues*, (10), 51–60.

- [10] An, Q., Liu, J., & Li, W. (2023). Digital inclusive finance and upgrading of household consumption structure: mechanism and empirical evidence. *Journal of Yunnan University of Finance and Economics*, 39(03), 1–23.
- [11] Chen, H., Chen, G., Wei, X., et al. (2021). Effect of Digital Inclusive Finance on Income Increase and Poverty Reduction: An Empirical Analysis Based on Interprovincial Panel Data. *Economic Geography*, 41(03), 184–191.
- [12] Wang, X., & Zhao, Y. (2020). Does Matthew Effect Exist in Digital Financial Development? --Comparison of Experiences of Poor Households and Non-poor Households. *Financial Research*, (07), 114–133.
- [13] Ma, C. (2019). "The fourth generation of human rights" and its protection in the context of an intelligent society. *China Law*, 211(05), 5–24.
- [14] Fang, N., Guo, F., & Lu, X. (2022). Does Digital Inclusive Finance Improve Elderly Happiness? --An Empirical Study Based on CHFS and DFIC Data. *Science of Finance and Economics*, 413(08), 32–46.
- [15] Yang, D. (2020). Reconstruction of Digital Economy Theory and Regulation System in Post-epidemic Era--Taking Competition Law as the Core. *People's Forum Academic Frontier*, 201(17), 48–57.
- [16] Yang, S., & Kong, R. (2021). Does digital financial market participate in improving farmers' income?. *Journal of Huazhong Agricultural University (Social Science Edition)*, (05), 180–190, 200.
- [17] Sekabira, H., & Qaim, M. (2017). Mobile money, agricultural marketing, and off-farm income in Uganda. *Agricultural Economics*, 48(05), 597–611.
- [18] Liu, H., & Zhang, G. (2022). Research on Happiness Effect and Mechanism of Digital Finance. *Contemporary Finance*, (04), 52–64.
- [19] Mou, T., Diao, L., & Huo, P. (2021). Digital Economy and Urban-Rural Inclusive Growth: Based on Digital Skills Perspective. *Financial Review*, 13(04), 36–57, 124–125.
- [20] Ellis, F. (1998). Household strategies and rural livelihood diversification. *The Journal of Development Studies*, 35(1), 1–38.
- [21] Khatun, D., & Roy, B. C. (2012). Rural livelihood diversification in west Bengal: determinants and constraints. *Agricultural Economics Research Review*, 25(1), 115–124.
- [22] Etea, B. G., Zhou, D., Abebe, K. A., et al. (2020). Is income diversification a means of survival or accumulation? Evidence from rural and semi-urban households in Ethiopia. *Environment, Development and Sustainability*, 22, 5751–5769.
- [23] Wang, J., & Lu, K. (2021). The realization path of narrowing the income gap within rural areas under the goal of common prosperity: an analysis based on the perspective of livelihood diversification. *Journal of Huazhong Agricultural University (Social Science Edition)*, (05), 34–44, 192–193.

- [24] Iqbal, M. A., Rizwan, M., Abbas, A., et al. (2021). A Quest for Livelihood Sustainability? Patterns, Motives and Determinants of Non-Farm Income Diversification among Agricultural Households in Punjab, Pakistan. *Sustainability*, 13(16), 9084.
- [25] Hu, J., Wang, Z., & Luo, J. (2023). Use of Digital Finance and Farmers' Happiness: An Empirical Study Based on Entrepreneurship Intermediary Perspective. *Journal of China Agricultural University*, 28(03), 250–264.
- [26] Zhuang, Z. (2022). Social Network, Education and Financial Literacy of China Residents: A Study Based on CHFS. *Sociological Review*, 10(04), 151–167.
- [27] Cai, Q., & Zhu, Y. (2016). Influence of social capital and income gap on village collective action: a case study of farmers' participation in small-scale farmland water conservancy facilities maintenance in three provinces. *Journal of Public Management*, 13(04), 89–100, 157.
- [28] Gu, C., Wang, F., & Luo, F. (2021). A study on the differences and influencing factors of happiness between urban and rural residents in China. *World Geographic Research*, 30(01), 179–191.
- [29] Geng, X., Gao, G., Li, X., et al. (2022). Research on Digital Inclusive Finance Promoting Rural Residents 'Entrepreneurship: An Empirical Analysis Based on CHFS Data. *Operations and Management*, 31(09), 153–160.
- [30] Yang, Y., Fan, R., & Jiang, J. (2022). Can digital participation improve the happiness of low-income families? --An empirical study based on CHFS data. *Fujian Forum (Humanities and Social Sciences Edition)*, (09), 39–53.
- [31] Chen, Z., & Ma, Y. (2022). Study on the effect of urban renewal on residents 'happiness in China--based on projection pursuit and panel spatial quantile model of genetic algorithm. *Management Review*, 34(08), 43–53.
- [32] Yin, Z., Yue, P., & Chen, X. (2019). Financial market participation, risk heterogeneity and family happiness. *Financial Research*, (04), 168–187.
- [33] Song, J., Bai, Z., & Liu, J. (2022). Empirical analysis on factors affecting farmers' credit constraints under the background of digital finance development--based on comparison between traditional credit and digital credit. *World Agriculture*, (03), 62–73.
- [34] Guo, H., Zhang, Y., Peng, Y., et al. (2020). Study on regional differences of digital financial development affecting rural residents' consumption. *Agricultural Technology and Economics*, (12), 66–80.
- [35] Ferrer-I-Carbonell, A., & Frijters, P. (2004). How important is methodology for the estimates of the determinants of happiness?. *The Economic Journal*, 114(7), 641–659.
- [36] Xie, L., Wang, Y., & Zhao, C. (2019). The impact of inclusive finance on residents' happiness: an empirical study based on CFPS data. *Population and Development*, 25(06), 65–75, 106.